A Qualitative Investigation of Low Emission Port Development

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Abstract: An in-depth interview study of the practice within low emission port was undertaken to ascertain strategy implication in green port issue. The main focus of the study was streamlined to emissions from ships and trucks. Interviews explored the specific strategies managers used to reduce air pollution from four ports in Taiwan and their perceptions of the efficacy of them. Research findings show that, when explored qualitatively and in-depth, the strategies that stakeholders (e.g. port authorities, terminal operators) should pay more attention to, such as the port planning and development, are seen from a broad perspective, and the mitigation strategy of air pollution should be flexibly designed and managed to achieve resource use rationalization and environment balance.

Keywords: Low Emission, Air Pollution, Port, Mitigation Strategy, Interviews, Qualitative Investigation

1. INTRODUCTION

Every port has its positive and negative impact on the economy and the environment (Bailey and Solomon, 2004). The expansion of international trade arising from globalization has led to a substantial increase in goods' transshipment between ports around the world. This phenomenon has led to increased emissions from ships in ports, and trucks traveling to and from ports, which, in turn, has produced significant external social costs. The construction, operation and expansion of a port may produce air pollutants, climate change, acidification, eutrophication, health, traffic congestion, and noise. These negative external impacts are significant but have seldom been highlighted as being environmental implications of port development in the past. The International Maritime Organization (IMO) has debated both technical and market-based measures for reducing greenhouse gas emissions from shipping, for example, lower ship speed (Lindstad et al., 2011) or rail mounted gantry cranes (instead of rubber tired gantry crane). Moreover, Sustainable Eco-port in Europe is a key step to become friendly and environmental maritime industry and help increase more trade and cooperation opportunity with other partners (Gul and Cimen, 2012). Today, it is important that the knock-on environmental impact of port development is considered and accounted for, since it has an influence on a nation's port planning and economy development. In particular, it can affect the nation's overall carbon emissions, and is becoming more of an issue in tandem with the importance of such overall emissions (Davies, 2006). These issues also have important impacts on stakeholders of the port, such as the community; from a health perspective, lower emissions has many implications, and from an economic perspective, any limitation of activity to reduce such emissions would also be significant.

To date, most studies into this area have ben quantitative in nature rather than qualitative. Qualitative studies would complement the quantitative studies that exist as they will allow for more in-depth 'human' perspectives (Denzin and Lincoln, 2005) regarding stakeholders' perceptions of the policies and recommendations the more quantitative studies suggest. This is important as it reveals how such policies are perceived, and therefore, the potential success of their take-up and implementation, particularly when they may involve significant changes to existing practices, which may be resisted (Machiavelli, 1532). The results of this study provide strategy implication for port stakeholders (e.g., port authorities, shipping operators). The paper is organized as follows: Section 2 reviews and summarizes some existing studies related to green and low emission port. Section 3 presents qualitative methodology that was used here. The study results and discussion are shown in sections 4. Finally Section 5 summarize research finding.

2. LITERATURE REVIEW

Many quantitative studies recognize the role of emission from ships as a significant source of air pollution and greenhouse gases (Lonati et al., 2010; Villalba and Gemechu, 2011). The main pollutant resulting from ship exhaust emissions are, by mass, carbon dioxide (CO_2), Sulfur dioxide (SO_2), nitrogen oxides (NOx), carbon monoxide (CO), particulate matter (PM), hydrocarbons (HC) and volatile organic compounds (VOC) (Fitzgerald et al., 2011; Tzannatos, 2010). Based on past studies (Deniz et al., 2010; Tzannatos, 2010), ship emissions at berth determine the concentration of exhaust emissions in ports and are between three to five times higher than from other activities in ports (e.g., maneuvering and cruising). Understandably, these emissions from ships at berth have become a great concern for port authorities (Berechman and Tseng, 2012).

Maritime experts have attempted to provide effective strategies to reduce emissions from shipping in light of the fact that climate change is now a global environmental concern (Gilbert and Bows, 2012). Various strategies have been presented within both academic and industry fields. For example, Yap and Lam (2013) have argued that on-going advances in cargo-handling systems, terminal design and pollution abatement technologies could help to alleviate the pressures on land use and the environment. Also, Liu and Tsai (2011) showed that traffic patterns analysis can be used to identifying vessels with higher risk (e.g. marine pollution). Analysis information includes vessel characteristics, maintenance records, and prior compliance history.

Using an inductive research approach, Hall et al. (2013) chose the twin ports in California of Los Angeles and Long Beach to identify and assess the initiation and implementation process of environment innovation. They argue that innovation content should contain new technologies and processes for handling and moving cargo, mechanisms for planning and policy making, as well as for financing, implementing, upgrading, managing and operating infrastructure systems. Lun et al. (2013) evaluated the external cost incurred from barge and containership usage in the Pearl River Delta (PRD) region and developed three green shipping networks servicing the region. Li et al. (2011) used a combination of qualitative and some quantitative methods to analyze and develop a low-carbon port in China. They suggested strategies such as setting standards of low-carbon port emissions, exploiting clean energy and increasing the support of policy and finance. In another quantitative study, Lindstad et al. (2011) investigated the effects of speed reductions on the direct emissions and costs of maritime transport. Further, based on literature review, Han (2010) presented three types of

mitigation strategies to reduce air pollution in the shipping industry: technological strategies (lower sulfur fuel and selective catalytic reduction), operational strategies (vessel speed reduction and shore-side power) and market-based strategies (environmentally differentiated fee, and cap and trade system).

In a quantitative study of Greek port, Georgakellos (2007) indicated that deposit–refund framework is useful method to motivate ships to act more environmentally responsible manner regarding their waste. With regards to international shipping studies, Corbett et al. (2009) found that a fuel tax of approximately $150/ton fuel would lead to 20-30% CO_2 reductions and a speed reduction mandate targeted to achieve a 20% CO_2 reduction in the container fleet costs between $30 and $200 per ton CO_2 abated. Similarly, Chang and Wang (2012) indicated that reducing ship speed and adopt onshore power supply system are effective strategies to reduce CO_2 emission in port. With regard to developing green ports, Bergqvist and Egels-Zandén (2012) developed a differentiated green port through internalizing external costs in the transportation systems and analyzed the effects of strategy in various stakeholders. Lun (2011) indicated that environmentally friendly operation help improve in firm performance in container shipping operators. In another recent study, Wuisan et al. (2012) found clean shipping target is difficult to achieve through private governance institution due to an insufficient level of collaborative advantage within partnership.

As is evident, the majority of these past studies mainly use quantitative approaches to survey the green port and related external cost issues, yet there is a paucity of empirical investigations that have collected stakeholder's opinion using qualitative studies, particularly in Asian countries. Despite this, qualitative approaches have been used in transport related fields, such as maritime safety (Mullai and Paulsson, 2011; Ikeagwuani and John, 2013) and bus transportation (Carreira et al., 2013) and landscape and urban planning (Heacock and Hollander, 2011). Nevertheless, ports, especially with regard to low emission port development, have seldom been investigated from a holistic perspective. The purpose of this study is to begin to fill this gap and present a comprehensive summarized finding after empirical interview research.

3. METHODOLOGY

This study adopts qualitative approach to understand the perceptions of industry experts and governmental officer's perceptions and responses to address the complex and unstudied phenomenon of low emission port policy. Based on grounded theory, qualitative analysis is used to obtain the intricate details about certain issue. To provide an in-depth understanding of low emission port development strategy, a qualitative study was undertaken in four international ports (Kaohsiung, Keelung, Taichung and Taipei) in Taiwan. All interviews were digitally recorded and literally transcribed (Maxwell, 1992) using a self-chosen code (Poland, 2001), then sent to the participants for verification. Interviews were conducted in Chinese (Cortazzi et al. 2011) and then translated using a decentering technique (Werner and Campbell, 1970) or skopos approach (Vermeer, 2004) to render a translation that was as natural as possible. Data collection involved various observation and interviews (including fifteen interviewees). The interview organizations included Taiwan International Ports Limited Company (Including Kaohsiung, Keelung and Taichung), Central Taiwan Maritime Affairs Center and Taipei Port Container Terminal Corporation. Questions were both semi-structured and open ended (Foddy, 1993) and based on key areas in the quantitative

literature such as port, terminal, shipping lines and shippers. These processes enhance the content of data analysis and theory development. To cover various factors of variability in low emission port development, the interviewees included president, director, port operation managers, terminal operators and other interested parties to better understand the policy implication.

4. Results and Discussion

Policy actions for controlling and reducing air pollution can be grouped into regulatory requirements and market-based (or incentive-based) categories (Wang et al., 2007). The perceptions of the interviewees from this study can be categorized into four mitigation strategies.

4.1 Economic Incentives to Mitigate Emissions

From an economic viewpoint, interviewees felt pollution externalities were social costs that should be borne by both suppliers and users of ships and trucks. To internalize these costs a Pigouvian Tax (Pigou, 1920) should be imposed on polluting activities thereby reducing ships and trucks non-optimal activity, i.e., an activity whose marginal social costs exceed its marginal social benefits. Since a ship's emission depends on how long the ship is at berth, given technology, time is a key factor affecting the magnitude of pollution costs. The longer the time, the higher the pollution costs.

A key question in welfare economics is what should be done with these tax revenues. In general, revenues generated from charges could be allocated to two main purposes: air quality improvement projects such as subsidies to provide incentives for ship owners to make ships' engines more energy-efficient. The second is to compensate a port's residents for health problems related to emission. In any case, the port authority should impose these taxes on ship activity, which in turn will reduce pollution and provide ship owners with an incentive to reduce emission.

4.2 Use Shore-side Power to Replace Auxiliary Engines

Another strategy interviewees felt could reduce ships emissions is to use shore-side power to replace auxiliary engines. Currently, ships' diesel auxiliary engines must continue to provide the basic power electricity for lighting, ventilation, pumps, cranes, and essential equipment while they are berthed (Hall, 2010). One alternative to control ships' emissions is to provide the electricity supply with universal plug equipment from the land instead of from ship engines (Salomon, 2009). Several successful cases have been implemented in different ports where shore-side electrical power has achieved significant reduction in CO_2 emissions: 99.5%, 85.0%, and 9.4% in Norway, France and the U.S., respectively (Hall, 2010). In terms of the encouragement of such a system, a port tax discount (or differentiated tonnage tax) could be implemented for ships when they use shore-side power.

4.3 Improve Operation Efficiency in Port

A third strategy interviewees noted was to improve operations efficiency in port. Since ship time at berth is an important factor that would affect its emissions in port, improving cargo operation efficiency (loading/unloading) at berth could further mitigate the severity of air pollution and externality. Currently, in order to achieve an efficient handling service, only three domestic shipping lines use lease-dedicated berths in Taiwanese ports. Other shipping lines which have no berthing priority have to queue for a berthing at a public berth. From a

green port management perspective, the port authorities could provide more lease-dedicated berth projects with proper rent reduction to reduce ship times at berth if the ship operators were to adopt certain environmental policies; for example, using diesel instead of traditional maritime heavy fuels (residual oils) when berthing at port.

4.4 Adopt Technological Innovations to Mitigate Emissions

Interviewees believed technology innovation provides many potential opportunities to reduce ship and truck emissions. For example, natural gas is available as a fuel source for smaller ships (e.g., tugboats and commercial fishing boats) at berth (Bailey and Solomon, 2004). Also, clean fuel (e.g., fuel cell, low sulpher fuel, biodiesel, liquefied natural gas) offers many advantages over existing diesel generators, such as low exhaust emissions (e.g., diesel oxidation catalyst and diesel particulate filter), improved thermal efficiency and electrification (e.g., automated vehicles and hybrid yard equipment). Also, shipping operators can further collaborate and cooperate with other organizations in the region for innovation.

5. CONCLUSION

In order to develop a low emission port, this study adopted a qualitative approach to collect and analyze various opinions of port stakeholders. This qualitative approach allowed access to more in-depth perspectives and these were categorized into four mitigation strategies focusing on emissions tax, shore-side power, port operation efficiency and technology innovation. We suggest that port planning and development should consider three important stakeholders which are port/terminals, carriers and shippers. Any mitigation strategies of air pollution should be flexibly designed and managed from a broad perspective. For example, port taxes (carbon tax) should be levied by the port authorities and paid by the ship owners. Increasing stakeholder acceptance and providing initiatives (e.g. port tax reduction via adopting energy-saving methods) to achieve resource use rationalization (or resource sharing) and environment balance.

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